

NASA CR-

141489TECHNICAL NOTEIMPROVED DENSITY DISCRIMINATION  
USING AGFACONTOUR FILM

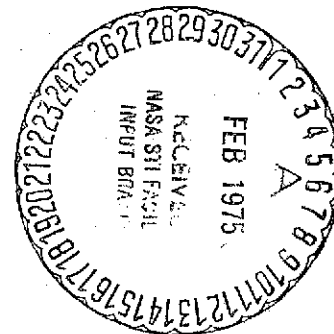
Prepared Under

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Task Order HT-58

Prepared By

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PhotoscientistORIGINAL PAGE IS  
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January 1973

Photographic Technology Division  
National Aeronautics and Space Administration  
Manned Spacecraft Center  
Houston, Texas(NASA-CR-141489) IMPROVED DENSITY  
DISCRIMINATION USING AGFACONTOUR FILM  
(Technicolor, Inc., Houston, Tex.)  
\$3.2521 p HC  
CSCL 14E

N75-15957

Unclas  
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G3/35



Technicolor Graphic Services, Inc.

IMPROVED DENSITY DISCRIMINATION  
USING AGFA CONTOUR FILM

This report has been reviewed  
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### SUMMARY

The purpose of this report is to document the technique developed by the Photo Science Office for obtaining tone separations from black-and-white photographic materials.

For informational purposes it is desirable to be able to separate from a photograph, certain areas which have densities within a narrow range. The technique employed utilizes Agfacontour film and photographic derivatives to improve the density discrimination and decrease the density range from 0.45 to 0.08 units. This increase in capability extends the usefulness of tone separations to a wider range of subject matter and problem areas.

## INTRODUCTION

Agfacontour Professional Sheet Film produced by Agfa-Gaevert can isolate all the areas of a black-and-white photograph having essentially equal densities. A Technical Note prepared under Task Order HT-42 documents some of the work previously accomplished with this material. This report documents the work of the Photo Science Office in improving the capabilities of this material. These improvements extend the usefulness of Agfacontour film in the analysis of multiband photography.

## PROCEDURES

In order to satisfy the requirements of one of the Earth Resources Aircraft Program Principal Investigators, there was a need for an analytical method of fine density discrimination. Previous density discrimination obtained with Agfacontour film had been approximately 0.4 to 0.5 density units; the discrimination needed for these requirements was about 0.05 to 0.10.

Several methods were investigated for improving the density discrimination. One method involved using a continuous wedge, rather than a step tablet, for the test exposures on the Agfacontour film. The continuous wedge allowed a better study of the discriminatory properties of the Agfacontour because there were no finite steps to limit the measurement precision.

Another technique involved using the I-B sensitometer to give more reproducible exposures. Also, it was desirable to use the I-B sensitometer because the equipment for this instrument included a precise continuous wedge.

Agfacontour exposures were made on the I-B sensitometer with 2650°K illumination and processed. The results proved to be less discriminatory than the previous test that had been made. Also noted was a U-shaped contour rather than a V-shaped contour. When duplicated under the high-contrast conditions, the sides of the "U" steepened, but did not narrow appreciably. In order to determine the effects of the illumination conditions in the sensitometer on the results of the tests, the continuous wedge was transferred to the enlarger that had been used for previous tests. Exposures were made on the enlarger using the continuous wedge. Test results under these conditions produced contours that were similar to those previously obtained.

Normal usage of agfacontour film requires a mild yellow color correcting (CC) filter. One step of these tests was to investigate the effect of increasing the strength of the yellow filter, which narrowed the density slice and increased discrimination. Yellow filters were tried over the filtration range 60YCC to 150YCC. With 150Y filtration, density slices 0.3 density units wide were obtained compared with 0.45 to 0.50 density units obtained with 50Y filtration on the enlarger or 0.60 density units wide on the I-B sensitometer.

The effects of increased development time were investigated. It was thought that this would improve the slice by steepening the contrast of the two sides of the slice. However, the results merely increased minimum density.

After the narrowest possible slice was obtained, further discrimination was found to be possible by duplicating with a contrasty material. Several materials were tried, and an experimental microfilm, type SO-291, was chosen. In D-19 developer, this duplicating material produced gammas from 3.0 to 4.8. It was concluded that if this material was used for both stages of the duplication, the overall gamma would be in excess of 22.0. Care must be taken to select the proper film/developer combination for maximum gamma. This same film, processed in D-76, gave a maximum gamma of 2.0.

When the Agfacontour film, exposed with a 150Y filter which produced a slice width of 0.3 density units, was duplicated with two stages of the SO-291 material developed in D-19 developer, the resultant slice width measured (at a density of 1.0 above minimum density) was 0.08. This procedure, exposure through the 150Y filter on the Agfacontour film and duplication with a high-contrast material, was then performed on aerial photographic material.

To measure the shape and width of the Agfacontour slices, or the dupes of the Agfacontour slices, a microdensitometer was used to trace the image of the continuous wedge.

## RESULTS

Using the following series of figures, the increased clarity of discrimination of small density differences of the original is illustrated.

Figure 1 - A microdensitometer trace of the 50Y exposure on the I-B sensitometer.

Figure 2 - A trace of the two-stage high-contrast dupe from Figure 1. Note the somewhat flat-bottomed shape of the trace of Figure 1, and the fact that duplicating does not narrow that portion of the trace.

Figure 3.- The results using no yellow filter.

Figure 4 - The results under the enlarger using a 50Y filter.

Figure 5 - The results under the enlarger using a 150Y filter.

Note the progressive narrowing of the slice with increased yellow filtration.

Figures 3, 4, and 5 show an increased sharpening of the profile of the slice to a V-shape.

A comparison of Figures 1 and 4 will show the effect of the change in the illumination from the I-B sensitometer to the enlarger.

Figure 6 - A plot of the width of the slice (as measured at 1.0 above minimum density) against the color and intensity of the filter used during exposure.

Figure 7 - A trace showing the results of the 150Y exposure, duplicated by the two-stage high-contrast method.

Figure 8 - A print made from the four pieces of film used for the traces in Figures 3, 4, 5, and 7, showing the visual appearance of these film pieces and the narrowing of the slice.

Figure 9 - A print of the aerial photograph from which separations were made.



Figure 10 - A print produced by making four slices from the previous aerial photograph at different density levels, and reproducing each one in a different color.

Slices were 0.3 density units wide and separated 0.3 density units apart.

Figure 11 - A composite similar to Figure 10, made with the slices 0.3 density units wide, but separated 0.08 density units apart.

Figure 12 - A similar composite made with the slices 0.08 density units wide, and 0.08 density units apart.

Through this series of figures, the increased clarity of discrimination of small density differences of the original is evident. This procedure shows great promise. Care must be taken to make the exposures precise, so that the slice occurs reliably at the desired density. Special care must be taken with the processing used for the high-contrast duplicating. Large variations can be introduced by uneven processing.

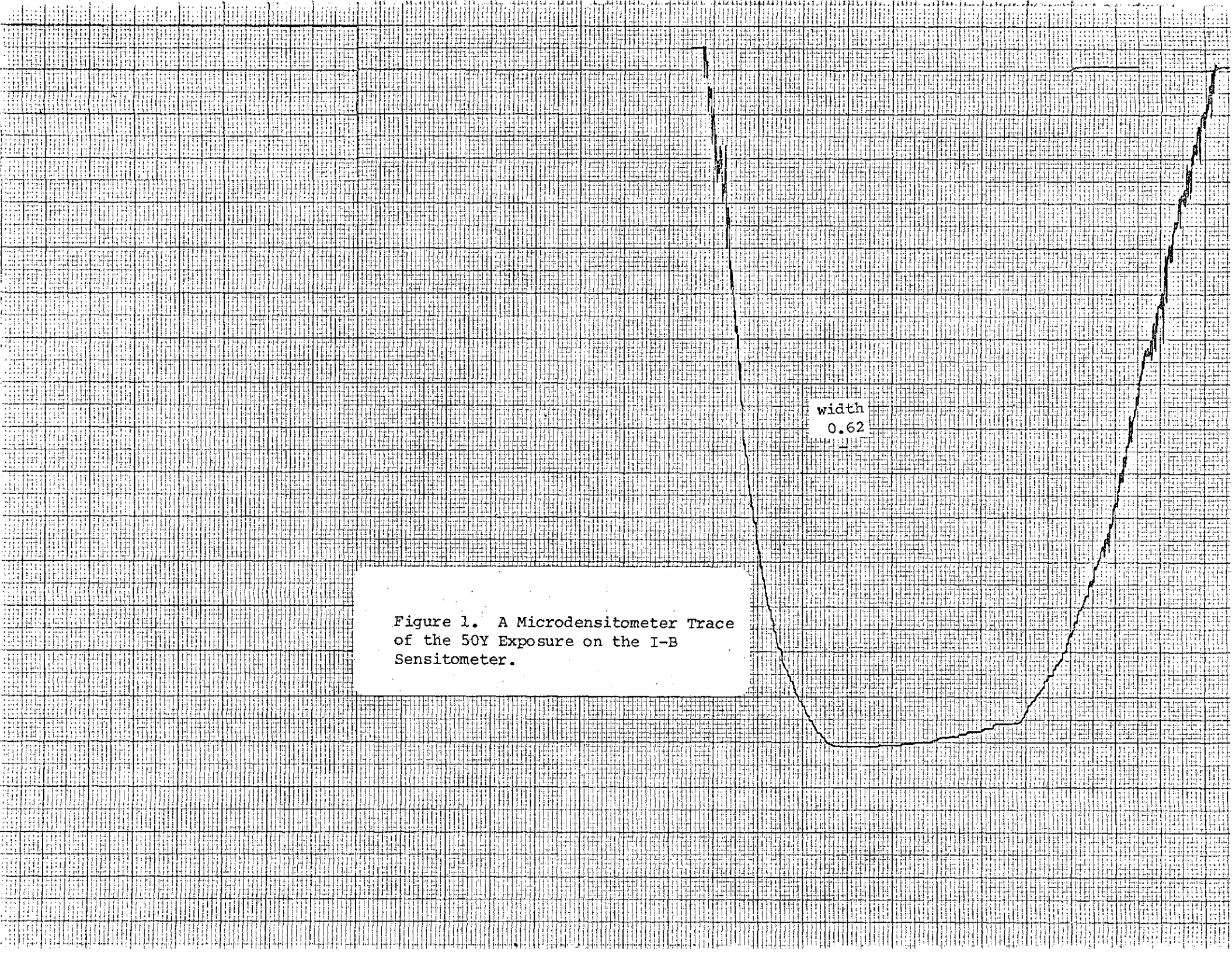


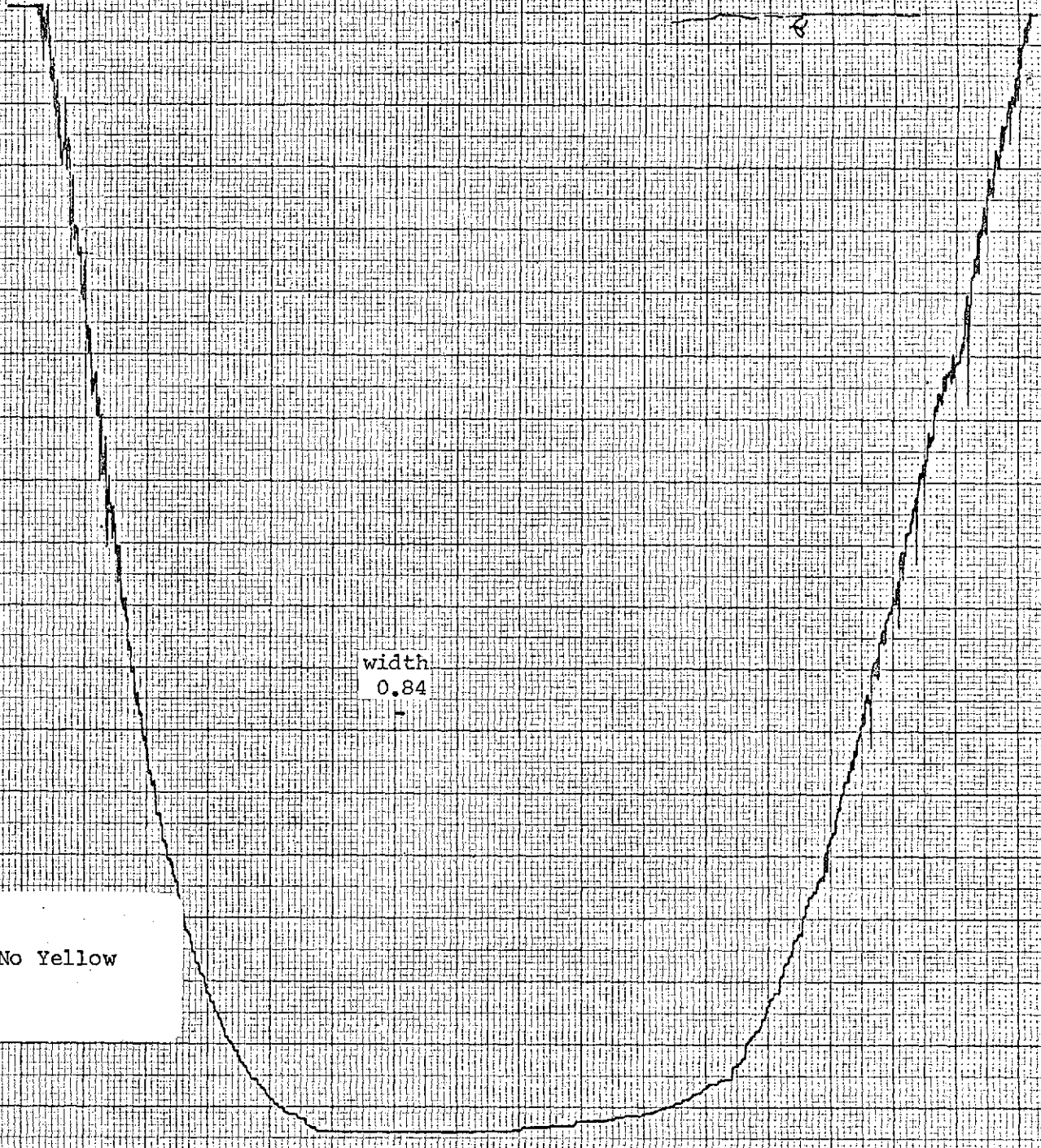
Figure 1. A Microdensitometer Trace  
of the 50Y Exposure on the I-B  
Sensitometer.

width  
0.62

Figure 2. Trace of the Two-Stage  
High-Contrast Duplicate from Figure  
1.







width  
0.84

Figure 3. Results Using No Yellow Filter.

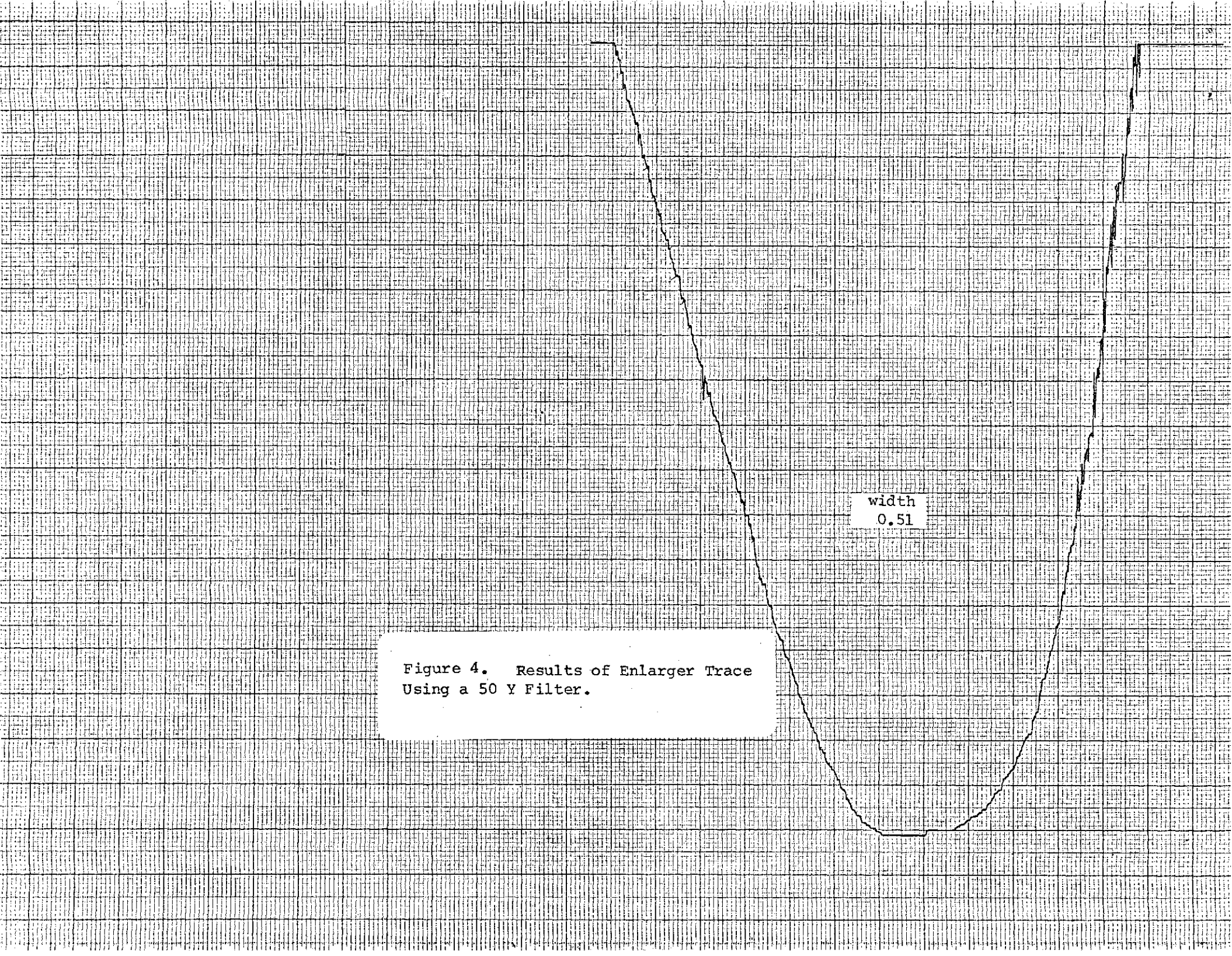


Figure 4. Results of Enlarger Trace  
Using a 50 Y Filter.

width  
0.51



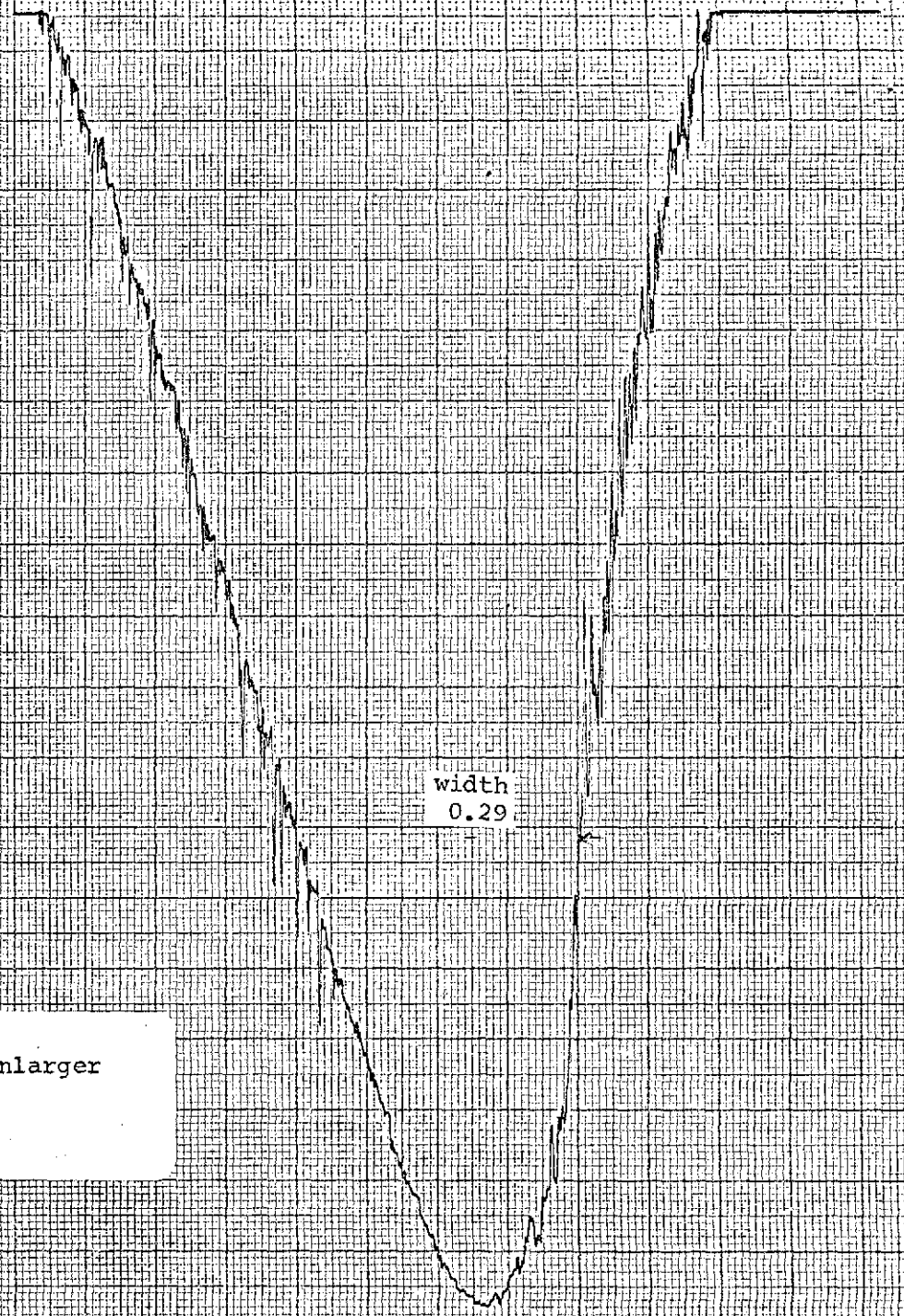
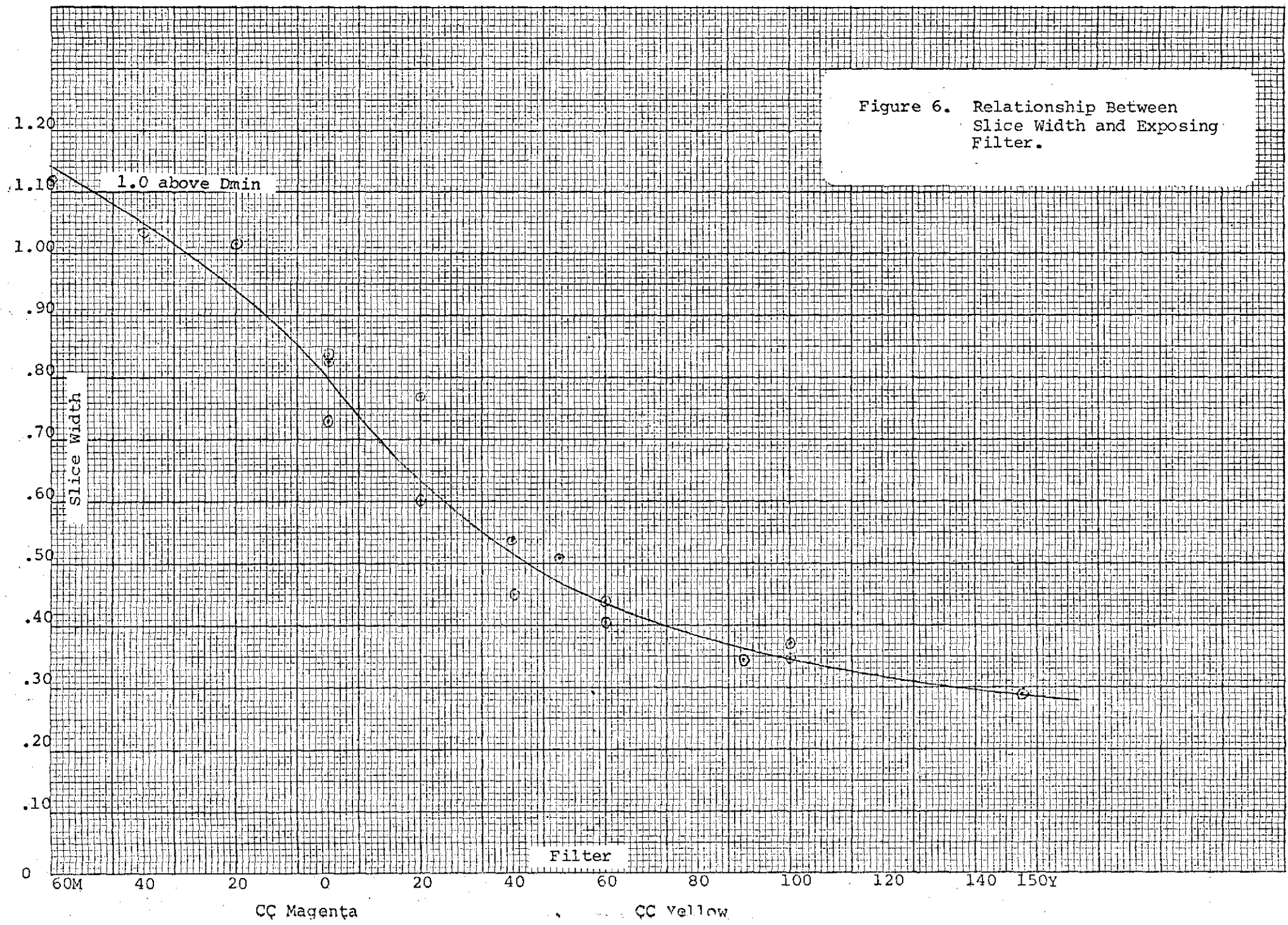


Figure 5. Results of the Enlarger  
Trace Using a 150Y Filter.



Positive

Negative

width  
0.08

width  
0.14

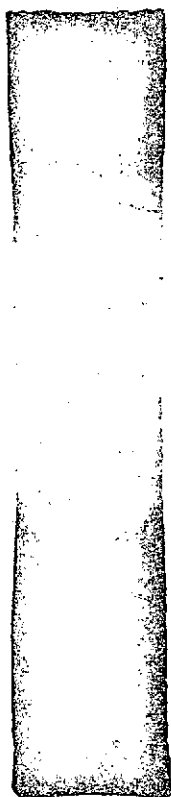
Figure 7. Results of 150Y Exposure,  
Duplicated by the Two-Stage High-  
Contrast Method.

Stage 2  
High  
Contrast  
Dup

Stage 1



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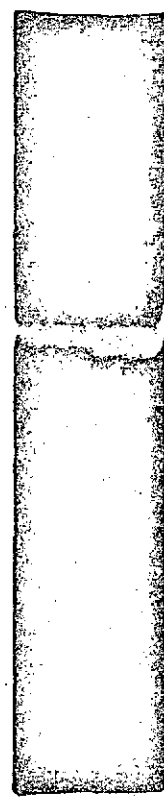
No  
Filter



CC50Y



CC150Y



High  
Contrast  
Dupe

FIGURE 8. Film Used for the Traces in Figures  
3, 4, 5, and 7.

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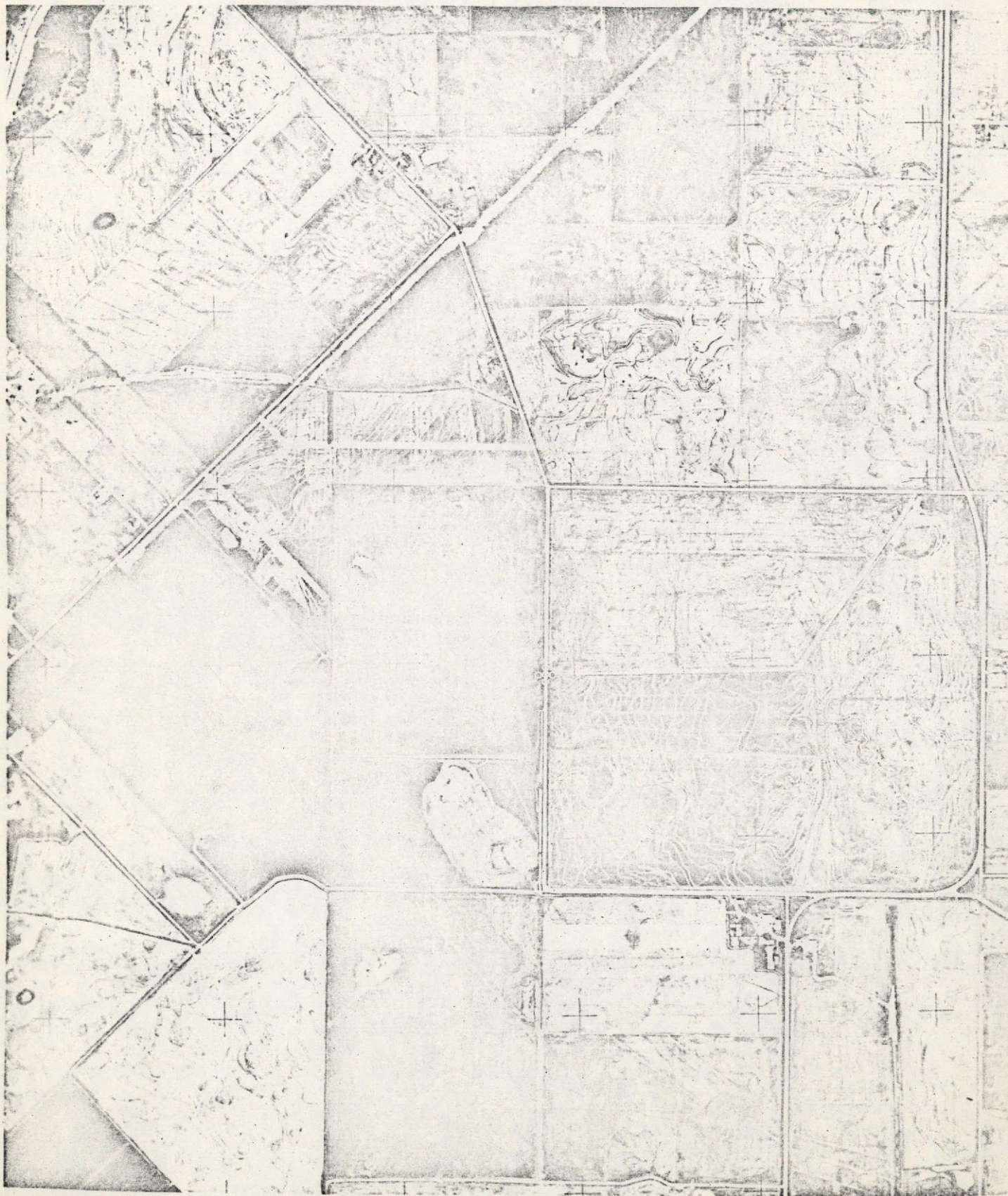






FIGURE 10

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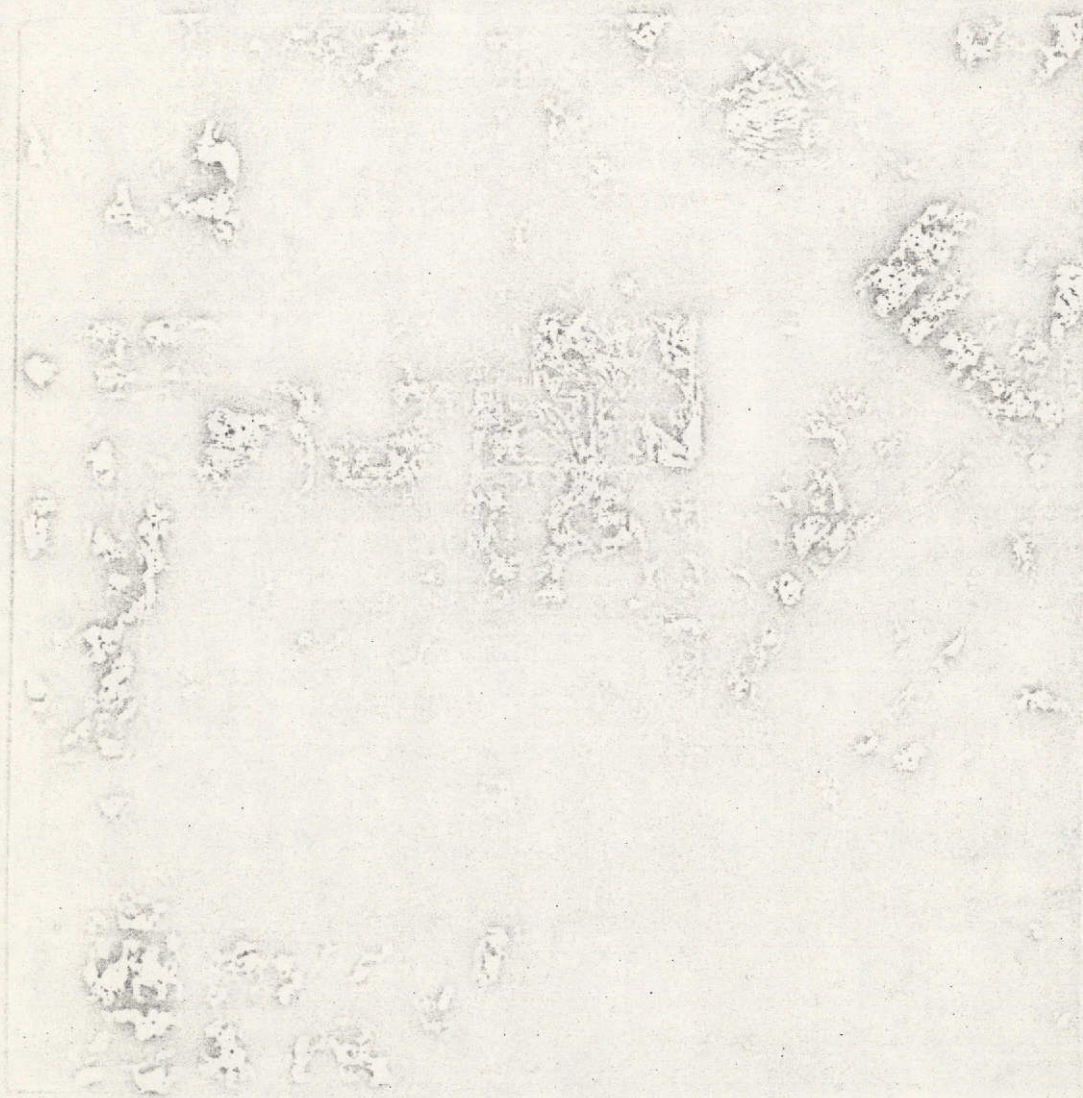


FIGURE 11

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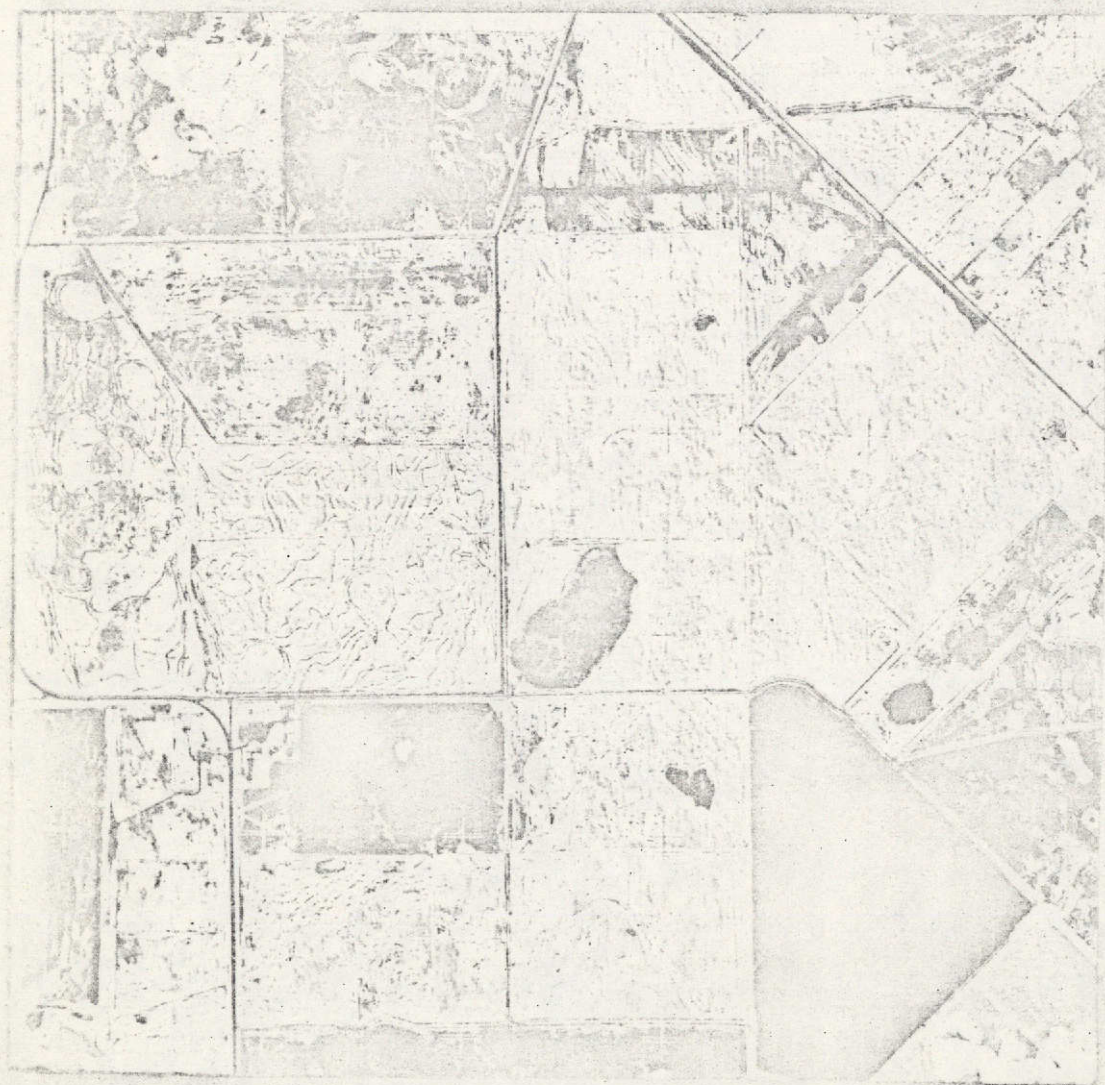


FIGURE 12

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